

Atty Docket No. RDRT 1004-2

PATENT

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims

Claim 23 (original): A method of forming a magnetoresistive device, comprising:

providing a substrate; and

forming a synthetic AFM layer having a first iron (Fe) layer and a second iron (Fe) layer separated by an iron-silicide (FeSi) layer.

Claim 24 (previously presented): The method of claim 23 wherein forming said synthetic AFM layer includes the use of molecule beam epitaxy (MBE) techniques.

Claim 25 (previously presented): The method of claim 23 wherein forming said synthetic AFM layer includes:

depositing a first iron (Fe) initial layer over said substrate;

depositing a silicon (Si) layer over said first Fe layer;

depositing a second Fe initial layer over said Si; and

heating said first Fe initial layer, said Si layer, and said second Fe initial layer until material from at least one of said first Fe initial layer and said second Fe initial layer propagates into said Si layer to transform said Si layer into said FeSi layer.

Claim 26 (currently amended): The method of claim ~~[[23]]~~ 25 wherein during said heating, material from the other of said first Fe layer and said second Fe layer also propagates into said Si layer.

Claim 27 (previously presented): The method of claim 25 wherein said heating is conducted to heat said first Fe layer, said Si layer, and said second Fe layer to a temperature in the range of about 150 degrees C to about 250 degrees C.

Claim 28 (previously presented): The method of claim 27 wherein said heating is conducted to heat said first Fe layer, said Si layer, and said second Fe layer to a temperature of about 200 degrees C.

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Claim 29 (currently amended): The method of claim 23 wherein forming said synthetic AFM layer includes:

- forming said first Fe layer above said substrate;
- forming said FeSi layer by sputtering Si and Fe ~~substantially simultaneously~~ over said first Fe layer and heating said Fe and said Si to form iron-silicide; and
- forming said second Fe layer above said FeSi layer.

Claim 30 (previously presented): The method of claim 29 wherein said heating heats said Fe and said Si to a temperature of about 200 degrees C.

Claim 31 (previously presented): The method of claim 23 further comprising:

- setting a magnetization of said first Fe layer in a first direction; and
- setting a magnetization of said second Fe layer in a second direction that is substantially antiparallel to said first direction.

Claim 32 (previously presented): The method of claim 23 wherein said FeSi layer includes between about 25% to about 75% Fe and Si forms up to the remainder of the FeSi layer.

Claim 33 (previously presented): The method of claim 32 wherein said layer including Fe and Si includes about 50% Fe and about 50% Si.

Claim 34 (previously presented): The method of claim 23 further comprising:

- forming a spacer layer over said synthetic AFM layer;
- forming a free layer over said spacer layer; and
- forming a pinning layer between said pinned layer and said substrate.

Claim 35 (previously presented): The method of claim 34 wherein said spacer layer is formed of a non-magnetic metal, said free layer is formed of a ferromagnetic material, and said pinning layer is formed of an antiferromagnetic (AFM) material.

Claim 36 (previously presented): The method of claim 35 wherein said spacer layer is formed of copper (Cu), said free layer is formed of one of CoFe and NiFe, and said AFM layer is formed of one of NiO, NiCoO, NiFeO, and Fe₂O₃.

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Claim 37 (previously presented): The method of claim 34 further comprising:
forming a first shield between said substrate and said AFM layer; and
forming a second shield over said free layer.

Claim 38 (previously presented): The method of claim 37 further comprising:
forming a metal spacer layer between said second shield and said free layer, including a
non-magnetic metal material.

Claim 39 (previously presented): The method of claim 34 wherein forming the spacer layer over
the synthetic AFM layer comprises forming a layer of Cu.

Claim 40 (previously presented): The method of claim 39 wherein forming a layer of Cu
comprises sputtering Cu.

Claim 41 (previously presented): The method of claim 34 wherein forming the free layer
comprises forming a layer of a ferromagnetic material selected from one of CoFe and NiFe.

Claim 42 (previously presented): The method of claim 41 wherein forming the free layer
comprises forming a layer of CoFe.

Claim 43 (previously presented): The method of claim 41 wherein forming the free layer
comprises forming a layer of NiFe.

Claim 44 (previously presented): The method of claim 34 wherein forming the pinning layer
comprises, prior to forming the synthetic AFM layer, forming a layer of an antiferromagnetic
material over the substrate.

Claim 45 (previously presented): The method of claim 44 wherein forming the layer of an
antiferromagnetic material over the substrate comprises forming a layer of an antiferromagnetic
material selected from the group consisting of NiO, NiCoO, NiFeO, and Fe₂O₃.

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Claim 46 (previously presented): The method of claim 44 wherein forming the layer of an antiferromagnetic material over the substrate comprises forming a layer of NiO.

Claim 47 (previously presented): The method of claim 44 wherein forming the layer of an antiferromagnetic material over the substrate comprises forming a layer of NiCoO.

Claim 48 (previously presented): The method of claim 44 wherein forming the layer of an antiferromagnetic material over the substrate comprises forming a layer of NiFeO.

Claim 49 (previously presented): The method of claim 44 wherein forming the layer of an antiferromagnetic material over the substrate comprises forming a layer of Fe₂O₃.